Space Weather Technical Forecast

Issued on Sunday, 23 October 2022 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Geomagnetic Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has been Very Low, with no further C-class flares observed. There are currently five sunspot regions on the visible Sun, with one unnumbered active region in the southeast. These are all currently small and simple regions with very little activity currently.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was at slow-ambient levels to start the period, before becoming slightly-elevated by 23/0500 UTC, with a further increase thereafter to elevated levels by 23/0900 UTC.. The density started above average, reaching a peak of 29 ppcc at 22/1703 UTC. After 22/1800 UTC density decreased to average levels. The IMF was mainly moderate close to the 10 nT level. The north-south component Bz started moderately negative and a peak value of -11 nT was observed at 22/1221 UTC. At 22/1906 UTC Bz became weekly positive before returning to Moderate negative values from 22/2215 UTC, and is now at weakly positive levels peaking at +8nT at 23/1002 UTC. The phi angle started positive (away from the Sun) until 22/1702 UTC when it rotated into a negative (towards the Sun) orientation. Geomagnetic activity was at Active to Minor Geomagnetic Storm level (Kp3-4) to start the period becoming Quiet to Unsettled (Kp2-3) by 22/2400 UTC, and Quiet (Kp1) by 23/1200 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16 has remained at Background levels. High energy electron flux (greater than 2MeV) at GOES16 was at normal background levels. The associated 24-hour integrated fluence was well below the Active (1e8 integrated pfu) threshold, with 1.93e6 integrated pfu observed at 22/2359 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is most likely to continue Low, perhaps falling to Very Low, but with a slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast period. Elevated solar winds are likely to reach Strong levels in the coming hours of Day 1 (23 Oct) and into Day 2 (24 Oct) as the fast wind from a coronal hole becomes established. Confidence is rather low in respect to both timing and strength, and is mainly guided by current Enlil expectations as well as a notable enhancement observed by STEREO A. Solar winds potentially easing from Day 3 (25 Oct) into Day 4 (26 Oct) but probably remaining at Elevated levels. Geomagnetic activity starting Quiet, may become Unsettled to Active at times and there is a decreasing Chance of Minor Geomagnetic Storms, especially during Days 1 and 2 (23 and 24 Oct).

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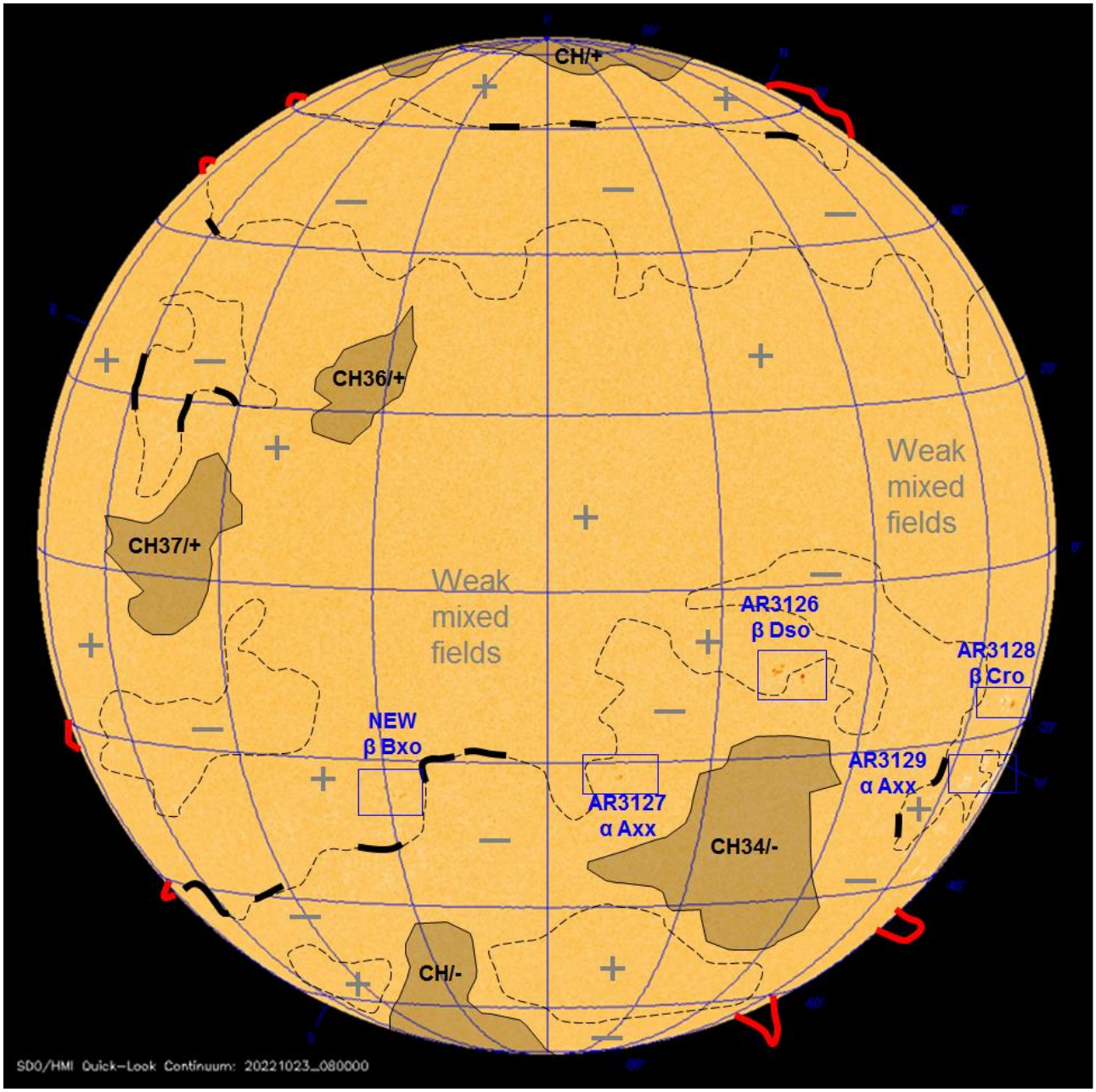
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at Background. High energy electron flux (greater than 2MeV) as observed by GOES16 is expected to peak at Moderate levels. A gradual rise to mainly High levels is then expected by the end of the period. The associated 24 hour fluence is expected to remain below Active (1e8 integrated pfu) at first, before rising late in the period, with a chance of rising above Day 4 (26 Oct).

Figure 1. Solar Analysis Valid 0800 UTC, 23 October 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

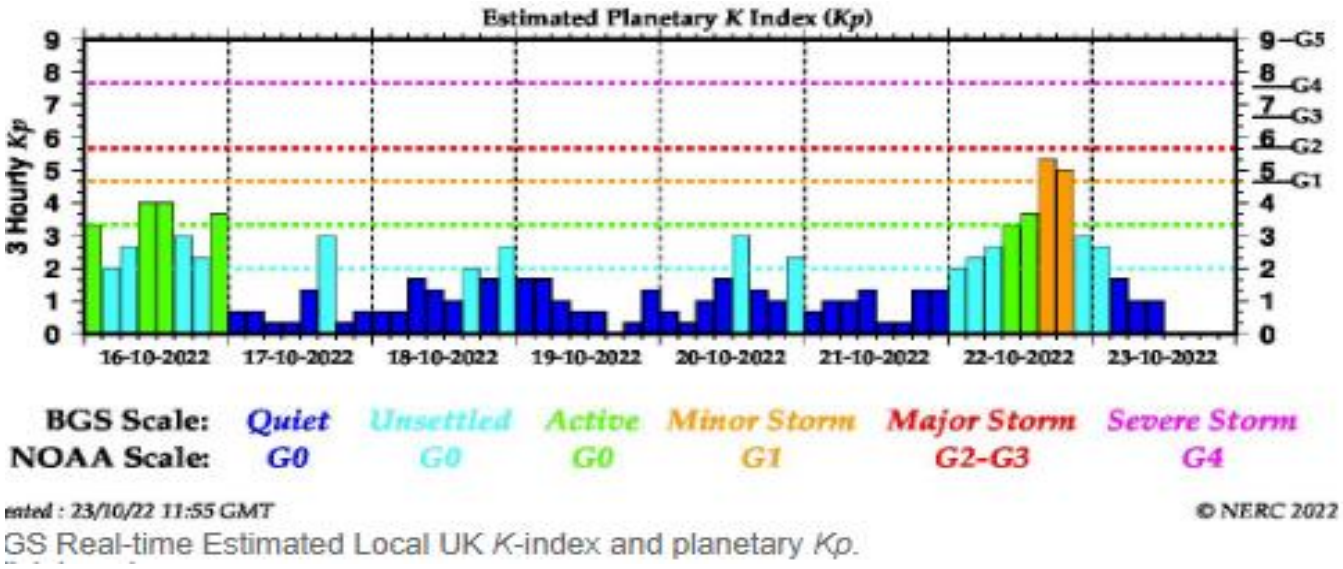
No Earth-directed CMEs currently feature in the forecast period.
The main feature of interest for this forecast period is the large southern negative polarity CH34. This is a recurrent CH with similar appearance to the previous rotation and. The Solar Winds Prediction Model (SWPM) indicated an arrival on Day 2 (24 Oct), with resultant solar wind speeds of 550 km/s. Conversely, however, MOSWOC Enlil is indicating a much earlier arrival, with solar winds peaking at 600 km/s early day 1 (23rd). Solar wind speeds have now become Elevated, and consequently solar winds at Earth will probably continue to increase, likely reaching speeds approaching 650-700 km/s. These Elevated to Strong winds (perhaps briefly Very Strong) will likely persist Day 2 (24 Oct), before gradually easing Day 3 (25 Oct).
Geomagnetic activity starting Quiet (Kp1-2), may become Unsettled to Active (Kp3-4) at times and there is a decreasing Chance of Minor Geomagnetic Storms (G1), especially during Days 1 and 2 (23 and 24 Oct).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	30	20	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS Magnetometer data for the past week with G1 levels observed for a time in past 24 hours.



GS Real-time Estimated Local UK *K*-index and planetary *Kp*.

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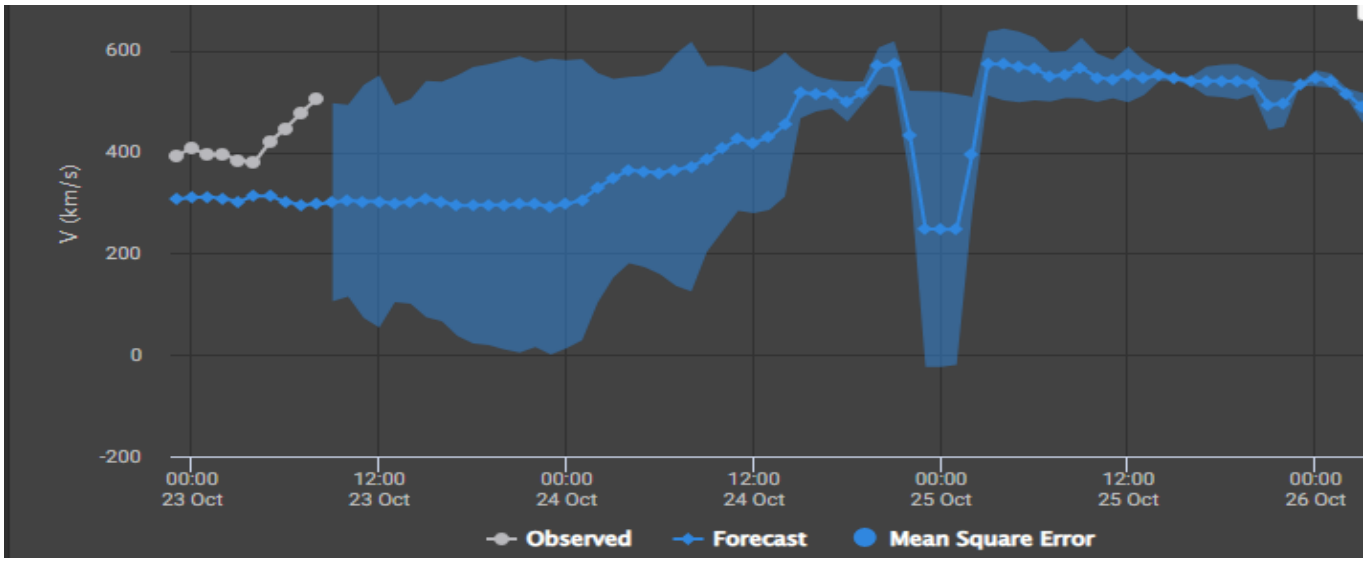
Radio Blackouts - X-Ray Flares:
Solar activity is currently Very Low, with five sunspots on the Earth-facing disc. Low or Very Low solar activity is expected to continue through the forecast period.
The sunspots are all relatively small and simple. AR3129 in the far southwest has simplified to Axx/Alpha region as it about to rotate across the limb. AR3128 (Cro/Beta) in the far southwest remains simple with little change as is also about the reach the limb. AR3127 (Axx/Alpha) near the southern centre disc continues to fade. AR3126 (Dso/Beta) in the southwest has shown minor development in the trailing spots. Finally a small and possibly transient region has recently emerged in the southwest and is classified (Bxo/Beta). A couple of active regions are anticipated to cross over from the far side of the disc during Days 2 and 3 (24 and 25 Oct). One in the northern hemisphere and perhaps a rather more interesting feature in the southern hemisphere. Probabilities in the table above reflecting this slight increase.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Met Office Solar Winds Prediction Model (SWPM), indicating elevated solar winds throughout.



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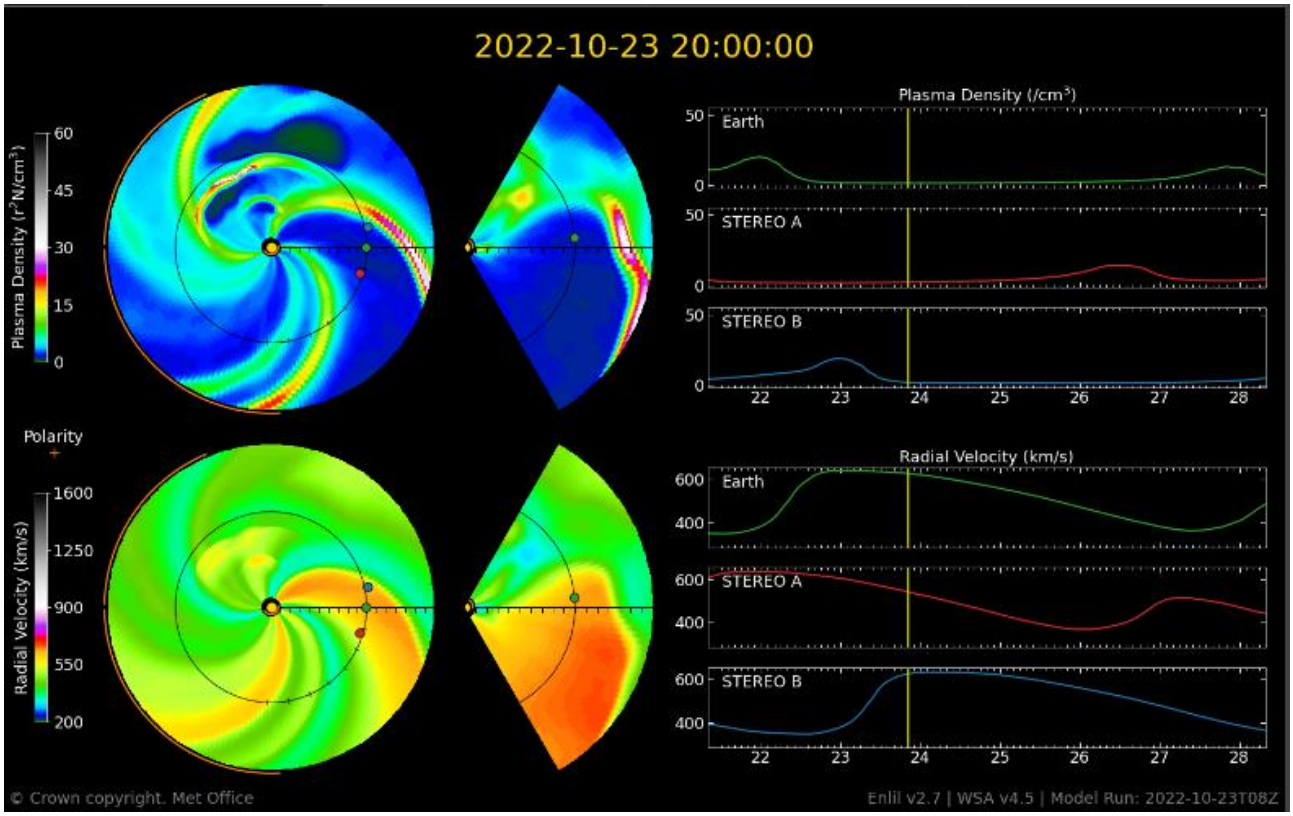
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as observed by GOES16 is currently at Background and expected to stay at this level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office ENLIL output showing HSS affecting Earth for next few days. The predicted onset by ENLIL was 12-18hrs too early.



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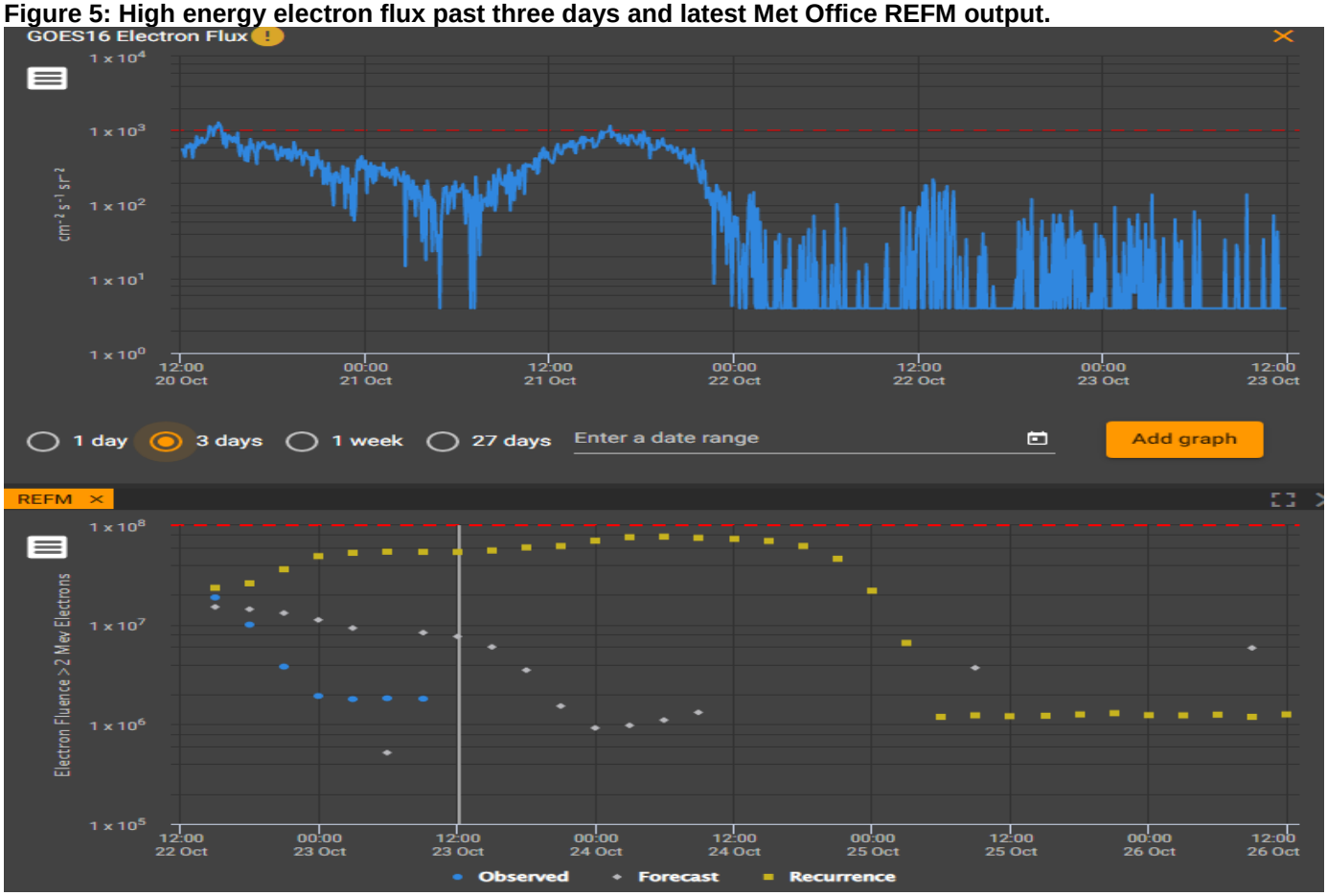
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) as observed by GOES-16 has been predominantly background. The High Speed Stream from CH34/- currently becoming established on Day 1 (23 Oct). There is significant uncertainty on both the timing and strength of this arrival, and hence in any subsequent increase in the observed electron flux. As solar wind pressure likely eases through day 3 and day 4 (25th and 26th), flux levels are likely to rise and are expected to become mainly High by the end of the period.
The associated 24 hour electron fluence is expected to remain below Active, but rising late in the period, especially as solar winds ease. There is a chance of Active fluence by day 4 (26th).
REFM is providing good guidance until T+24, but should be used cautiously beyond this due to the potential earlier fast wind arrival compared to persistence.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	20	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	2	5

Figure 5: High energy electron flux past three days and latest Met Office REFM output.



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